CATASTROPHIC DISRUPTION OF ASTEROIDS: FIRSTS SIMULATIONS WITH EXPLICIT FORMATION OF SPINNING AGGREGATES BY GRAVITATIONAL REACCUMULATION

P. Michel [1] and D.C. Richardson [2]

1. *Côte d'Azur Observatory, CNRS, France.*
2. *University of Maryland, USA*

We have recently made a major improvement in the simulations of asteroid disruption by computing explicitly the formation of aggregates during the gravitational reaccumulation of small fragments, allowing us to obtain information on their spin, the number of boulders composing them or lying on their surface, and their shape. We will present the first and preliminary results of this process taking as examples some asteroid families that we reproduced successfully with our previous simulations.

In the last six years, we have simulated successfully the formation of asteroid families using a 3-D Smoothed Particle Hydrodynamics (SPH) code to compute the fragmentation phase following the impact of a projectile on the parent body, and the parallel N-body code `pkdgrav` to compute the mutual interactions of the resulting fragments, including gravitational reaccumulation (Michel et al. 2001, 2002, 2003, 2004a,b). We found that when a km-size asteroid is disrupted by a collision, it can generate several hundreds of thousands of fragments whose masses are still large enough to be attracted by each other during their ejection. As a consequence, many reaccumulations can take place, so that at the end of the process most of the large fragments correspond to gravitational aggregates formed by reaccumulation of smaller ones. Moreover, this process leads to the formation of satellites (at least temporary ones) around the largest and other big remnants (e.g. Michel et al. 2001, Durda et al. 2004).

However, the main limitation of these previous simulations is that when fragments reaccumulate, they simply merge into a single sphere whose mass is the sum of the masses of these fragments. Thus, no information is provided on the actual shape of the aggregates, their spin, and on the quantity of small boulders composing them or lying on their surface. For the first time, we have simulated the disruption of a family parent body by computing explicitly the formation of aggregates along with the above-mentioned properties. We will present these first simulations and their possible implications for the properties of asteroids generated by a disruption. Such information can for instance be compared with data provided by the Japanese space mission Hayabusa of the asteroid Itokawa, a body now understood to be a fragment of a larger parent body.

References

Durda D.D., Bottke W.F., Ence B.L., Merline W.J., Asphaug E., Richardson, D.C., Leinhardt Z.M., 2004; Icarus, 170, 243-257.

Michel P., Benz W., Tanga P., Richardson D.C., 2001; Science, 294, 1696-1700.

Michel P., Benz W., Tanga P., Richardson D.C., 2002; Icarus, 160, 10-23.

Michel P., Benz W., Richardson D.C., 2003; Nature, 421, 608-611.

Michel P., Benz W., Richardson D.C., 2004; Icarus, 168, 420-432.

Michel P., Benz W., Richardson D.C., 2004; Planet. Space. Sci., 52, 1109-1117.